

A NEW BRITTLE STAR OF THE GENUS *ASTROPHIURA*
FROM SOUTHERN CALIFORNIA*

By FRED C. ZIESENHENNE

Allan Hancock Foundation
University of Southern California

The first *Astrophium* from Southern California was dredged in 1940 and additional specimens were dredged in 1941. These specimens were small and with limited available literature; they were presumed to be the young of *Astrophium permia*, Sladen (Ziesenhenné, 1941, p. 117). In 1949 some larger additional specimens were dredged with distinctive characteristics, upon which the basis for a new species could be described. A number of specimens were sent to Dr. Th. Mortensen, of Copenhagen, Denmark, who recommended the description of a new species.

OPHIOLEPIDIDÆ Ljungman 1867

ASTROPHIURA Sladen 1878

ASTROPHIURA MARIONÆ new species

Plate 13

Description.—Disk-body diameter, 5.8 mm.; diameter of disk, through distal edges of radial shields, 3.2 mm.; height of disk-body, 1.5 mm.; length of free arm beyond the margin of disk-body, 4 mm. The disk-body is pentagonal, convex upper surface and concave under surface, interbranchial margins almost straight. The upper arm segments are slightly elevated to form a noticeable ridge, radially, extending to the margin of the disk-body. Between the arm ridges the disk-body is slightly concave proximally, becoming straight distally at the interradial margins. The upper surface of the disk consists of 36 large, smooth, plates; including the radial shields. The upper side arm plates are fused, umbrella-like, to form the distal portion of the disk-body beyond the radial shields. The central plate is large, pentagonal, the margins are in contact interradially with five, smaller, rectangular basal plates, which are slightly broader than long. Distal to the basal plates is a second series of five, rectangular interradial plates of equal or slightly larger size. In one interradius this plate appears to be fused with a distal plate. The third series of five interradial plates are larger, rectangular, decidedly longer than wide; the lateral

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Fig. 1

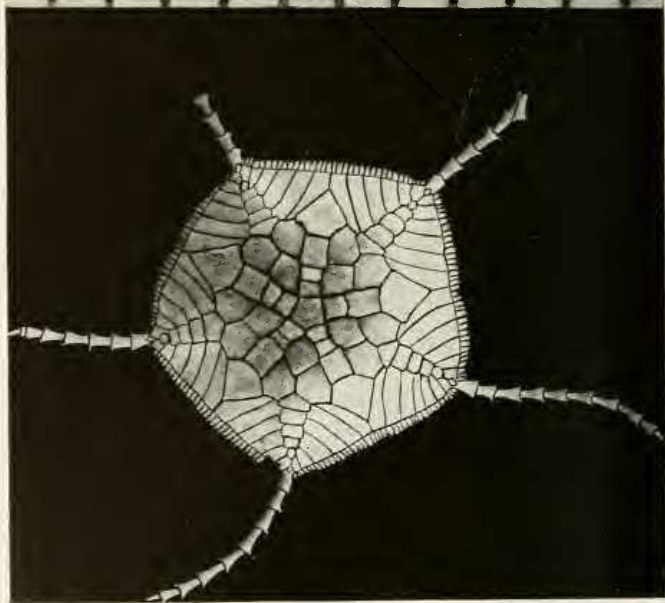
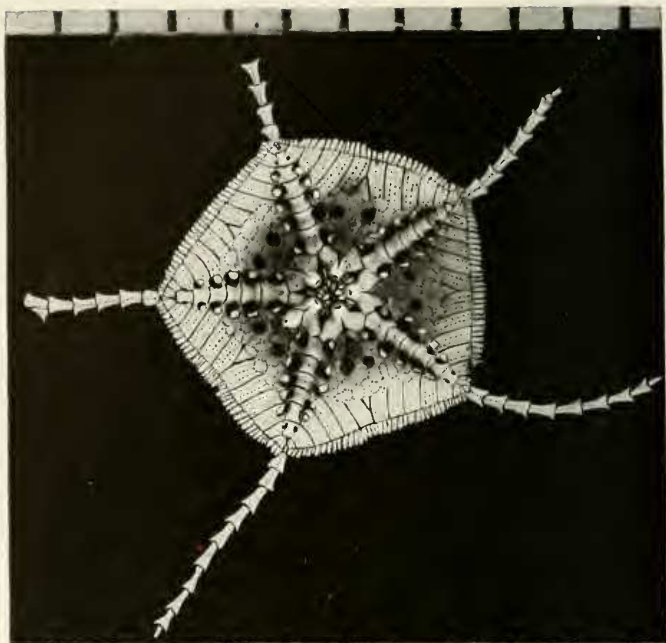


Fig. 2

PLATE 13

FIG. 1. Undersurface *Astrophium marionae* n. sp.
FIG. 2. Uppersurface *Astrophium marionae* n. sp.
Scale shown in millimeters.

margins are in contact with the interrarial proximal margins of the radial shields. The fourth interrarial series of five plates consist of exceedingly large, spear-shaped, irregularly pentagonal plates, equal to the radial shields in size. The three proximal margins are about one half the length of the distal lateral-margins. The proximal margin is in contact with the distal margin of the third series of interradians; proximal lateral margins are in contact with the radial shields. The distal lateral concave margins are in contact with the interrarial margins of the long, narrow, curved, modified side arm plates of the first proximal arm segment. Radially, and with the proximal angles barely in contact with the central plate are the five large radial plates. The radial plates are larger than the central plate, roughly diamond-shape, longer than wide, proximal margins longer than the distal margins, distal margins in contact with the radial shields. All disk plates are flat and smooth, lacking knobs or any other type of ornamentation.

The radial shields are large, exceeded in size by the fourth, distal-most interrarial spear-shaped plate; roughly hexagonal, longer than broad. Proximal angle is not quite a right angle; proximal apex of each pair of shields is separated by distal margins of the radial plate. The proximal margin is the longest, in contact with the radial and third interrarial plate, distal and distal-lateral margins short. Abradial-lateral margin is in contact with fourth series interrarial plate. Distal radial-lateral margin is in contact with first modified side arm plate and the distal margin is in contact with this second upper arm plate. Inner margins of the radial shields are in contact with each other for about two-fifths of their length. The distal portion of the radial shields cover the first upper arm plate. Beyond the disk proper, the remainder of the disk-body is composed of upper arm plates and modified side arm plates of the first six proximal arm segments. The side arm plates extend interradi ally and the outer margin of the first side arm plate from one radial contacts the outer margin of the side arm plate from an adjoining radial. Side arm plates two to six fuse in a like manner and the side arm plates become shorter in size gradually to the sixth, which is the shortest. The distal margin of each plate bears three, sometimes four, flat, papillæ, length about three times the diameter, fused laterally, to form a picket fence, their distal ends form the interrarial margins of the disk-body. There are thirty to thirty-eight spinelets in each interradius.

The second upper arm plate is the proximal upper arm plate visible beyond the radial shield. It is the largest of the upper arm plates, triangular in shape, broader than long, with an obtuse proximal angle. The third, fourth, and fifth upper arm plates are rectangular in shape. The third and fourth are broader than long

and the fifth is almost square, slightly broader than long. The sixth upper arm plate is small, diamond-shape, with acute distal and proximal angles, barely longer than wide. The sixth and seventh upper arm plates are separated by the side arm plates. The seventh upper arm plate is very small, triangular, and the last upper arm plate in the series.

The first side arm plate is curved, about five times as long as wide, outer proximal margin in contact with the large, spear-shaped, fourth series of interradial plates; outer distal margin in contact with corresponding side arm plate from adjoining arm for half the length of the margin. Second to sixth side arm plates are in complete contact with lateral margins of adjoining side arm plates. The side arm plates gradually become shorter to the sixth arm plate, which is only slightly longer than wide. A series of longitudinal ridges, parallel to lateral margins, is found on each side arm plate. The number of ridges conform with the number of spinelets on the distal margin of each plate. The free arms beyond the disk-body are delicate, slender, gradually tapering distally, consisting of ten abortive arm segments. The distal segment is reduced to a terminal spine, about three times the size of the arm spines. Both upper and under arm plates, tentacle pores, tentacle scales, and tube feet are lacking on the free arm segments. The first and second free arm segments are short, not quite twice as wide as long. Succeeding side arm plates become narrow and longer distally, length more than twice the width, trumpet-shape, wider distally, narrow proximally. Distal margin of each side arm plate bears one, small, short, peg-like spine, about twice as long as wide.

Oral shields are lacking. The madreporite plate is small, roughly oval-shaped, longer than wide, with the duct opening visible. Adoral plates not distinguishable under seventy-five power magnification. Oral plates relatively large, longer than wide, touching only at raised proximal ends, irregular-pentagonal, proximal median margin straight and short, interradial margin concave, more than twice the length of the proximal median margin. The distal margin is convex, in contact with the first under arm plate and first pair of tentacle pores. Two adradial margins almost straight, forming a wide obtuse angle. Jaws small, triangular, proximally pointing upward into the mouth and distally sloping away from the mouth, to contact outer margins of proximal raised ridge of oral plates. The jaw is separated from oral plates, along median margins, by a triangular, membrane-covered area. Each jaw bears at its apex a broad, flat, acute-tip, spear-shaped tooth, longer than the length of the jaw. The tooth points outward from the mouth. Both the tooth and the jaw are composed of semi-transparent plates. Oral papillae two in number, proximal papilla is acute, flat, longer than wide, attached to the jaw, in contact with oral plate. The second papilla is blunt, edge

slightly concave, about twice as wide as long, attached to the oral plate.

Interbrachial spaces below are covered by a fine membrane that extends distally to the modified side arm plates of the disk-body. Imbedded in the membrane are large semi-transparent polygonal plates, about sixteen to twenty-two in each interradiar area. The under surface of the disk-body is concave. There are six pairs of large, conspicuous tentacle pores in each radius, proximal pair largest, each pair separated from each other by an elevated ridge on the under arm plates. Genital slits consist of two large circular openings in each interradius, about the size of the first tentacle pore, located interradially from the second tentacle pore, about the same distance as separates the first and second tentacle pores. In alcoholic transparent specimens, the dark gonads extend distally to the margin of the disk-body proper. Under arm plates are hour-glass-shaped, longer than wide, with the central portion constricted. The distal and proximal margins are elevated and enlarged to form a ridge, which separates the pairs of tentacle pores. The under arm plates become progressively smaller distally to the seventh under arm plate, at the margin of the disk-body, which is small, abortive, triangular in shape, and longer than wide. The free arms beyond the disk-body lack under arm plates. A large, single, broad, triangular tentacle scale, longer than wide, is located on the proximal, abradial margin of the tentacle pore. The succeeding tentacle scales gradually become smaller distally, to the sixth pore, where they are entirely lacking.

Color.—In life, still attached to the boulder, the upper arm plates and disk are straw-tan. Through the transparent disk the gonads form a star-shape of a darker color, brownish-black, with the edges of the gonads showing a tinge of brick red. Under surface of disk; the buccal cavity area is almost black, due to the mud content of the mouth. The oral plates are light gray. The jaws are light tan. The under arm plates are straw color. The tentacles are reddish-pink. The proximal interradius is dark brown, almost black. The gonads seen from the under side of the disk are brick red. The disk proper is darker than the fused side arm plates, which are straw colored. The free arms are straw color, semi-transparent. The color in alcohol is dark straw color; the contents of the buccal cavity dark brown and the outline of the tentacle pores and the tube feet light brown. The gonads are reddish brown. Specimens dried from alcohol are white, with the dried tube feet tan; gonads dark brown, and buccal cavity gray-black.

Type.—Holotype, A.H.F. No. E. 57; 82 paratypes.

Type locality.—Holotype and twenty-five paratypes from Station 1988-50, 230 fms. boulders, Bank, 6 miles east of Long Point,

Santa Catalina Island, California, August 12, 1950; one paratype from Station 1156-40, 230 to 380 fms. boulders, Bank, 6.5 miles east of Long Point, Santa Catalina Island, California, July 7, 1940; eight paratypes from Station 1306-41, 228 to 267 fms. boulders, 7 miles east of Long Point, Santa Catalina Island, California, May 3, 1941; eighteen paratypes, five now in the Zoological Museum, Copenhagen, Denmark, from Station 1862-49, 250 to 320 fms. boulders, Bank, 6 miles east of Long Point, Santa Catalina Island, California, July 1, 1949; eight paratypes from Station 1989-50, 330 fms. 4.5 miles E.N.E. of Avalon, Santa Catalina Island, California, August 12, 1950 and twenty-two paratypes from Station 1992-50, 230 to 250 fms. boulders, Bank, 6 miles east of Long Point, Santa Catalina Island, California, August 23, 1950.

Remarks.—The seventy-eight specimens in the collection from Southern California waters range in size from 1.6 mm. to 9.5 mm. in disk-body diameter. Only one specimen, with two central plates, differed from the symmetrical rosette arrangement of the thirty-six disk plates. Only two of the largest specimens had seven pairs of tentacle pores and the smallest had three pairs of tentacle pores. The majority had six pairs of tentacle pores. Only twenty-one specimens had three oral papillæ and the largest specimen had only two oral papillæ. The three specimens with disk-body diameter of less than two mm. had only one free arm segment. Only eleven specimens had more than one arm spine; in those, the two or three arm spines were on the first and second free arm segments. The arm spines were fused to form a comb or fence; probably a step in the development of forming the distal marginal fence as the side arm plates are incorporated into the disk-body. The genital slits were not observed in the smaller specimens. Only a few of the larger specimens had more than ten free arm segments, one had twelve and another had eleven. Little is known about the biology of this species as it lives attached to boulders, that have been dredged up from 230 to 380 fathoms of water off the east end of Santa Catalina Island, California. The larger boulders support the greater colonies, as high as seven specimens were taken from a fifty-pound boulder. The boulders are of basaltic rock, worn smooth, and with few marine organisms growing upon them. Since the dredge rarely fouls on the bottom and mud is always present in the hauls, it is presumed the boulders are scattered over the bottom and ocean currents keep the mud from covering the rocks. In their known natural environment the pressure varies from 612.7 to 1012.3 pounds per square inch. Once on deck under atmospheric pressure the specimens are sessile, and remain clinging to the rocks, even upon drying. No motion has been observed of the free arms of freshly dredged specimens. The concave under side makes a fine suction cup and the large tube feet assist the brittle star to hold tightly to the

smooth basaltic rocks. By clinging to the smooth rock, the animal is secure from being carried away by the strong currents. The disk-body is a strong shield of armor that prevents smaller natural enemies from attacking the tender under side, and permits the animal to feed within the protection of the disk-body. The feeding habits are unknown. The specimens may raise the disk-body and feed on particles carried by the ocean currents as barnacles and oysters feed. The disk-body suggests feeding habits similar to the abalones, limpets, and chitons that move over the surface of the rocks. Of all the specimens examined in the laboratory, only one had a recognized organism in the buccal cavity. The organism was a Helizoon covered with numerous outstanding glass spicules. Besides serving as a protective and feeding space, the concave under surface could also serve as a brood pouch, as is common to other brittle stars. To date, all specimens were dredged during the summer months and the young have not been observed. The three smallest specimens were fastened to the boulders independently, as were the larger forms.

The present species differs from *Astrophiura kawamurai* Matsumoto, from the Sagami Sea, Japan by:

1. Lacking the five infrabasal disk plates and having an additional five interradial plates.
2. The infrabasals, basals, and interradial plates are not elevated above the central, radials, and radial shields to form a system of ridges.
3. The radial plate is diamond-shaped, proximal angle in contact with the centrodorsal plate, while in *A. kawamurai* the radial is definitely pentagonal and the proximal margin is in contact with the infrabasal plate.
4. The modified side arm plates of the disk-body are longer, narrower and curved, occupying a greater portion of the disk-body, normally six and rarely seven segments within the disk-body, compared to eight or nine in *A. kawamurai*.
5. The radial shields are hexagonal, straight margins, longer than wide, median margins in full contact with each other for two-fifths of their length. The radial shields in *A. kawamurai* are rounded-triangular, curved margins, hardly touching each other.
6. The fourth large interradial spear-shaped plate is as wide as long. In *A. kawamurai* this plate is longer than wide and the latero-distal margins are concave, more than twice the length of the other margins.
7. The disk-body is definitely raised, convex on the upper and concave on the under surfaces. Not at all flat as in *A. kawamurai*.
8. Oral papillæ two, rarely three to a side as compared to four or five in *A. kawamurai*.

9. Because of the longer side arm plates within the disk-body, the under surface area covered with the fine scale-imbedded membrane is smaller.

10. In all but the smallest specimens the genital pores are visible.

Astrophium marionae differs from *Astrophium cavellae*, Koehler, from the Cape of Good Hope, Atlantic Ocean, by:

1. The absence of a central cluster of spinelets, bosses, knobs or any other type or ornamentation on the primary disk plates.

2. The disk area being smaller and the fused side arm plates occupying a greater area of the disk-body. In *A. cavellae* the large fourth interradial plate almost reaches the disk-body distal margin and a smaller portion of the under side arm plates are exposed.

3. The infrabasal plate is lacking between the centrodorsal and radial plate and there are four series of interradials as compared to only three in *A. cavellae*.

4. The centrodorsal and radial plates are larger than the surrounding plates. In *A. cavellae* the centrodorsal and the surrounding plates are of about equal size.

5. The radial plate is diamond-shaped while in *A. cavellae* it is pentagonal.

6. The basal or first interradial is rectangular, while in *A. cavellae* it is pentagonal.

7. The madreporite plate is roughly oval-shape while in *A. cavellae* it is pentagonal.

8. Oral papillae in *A. cavellae* are long, narrow and acute-pointed, three or four to each side.

9. Free arms beyond disk-body lack upper and under arm plates.

10. Radial shields in *A. cavellae* are barely touching each other.

The present species differs from *Astrophium permira*, Sladen, from Madagascar in the Indian Ocean by:

1. The regular, symmetrical rosette arrangement of the 36 disk plates.

2. Absence of a central boss, knobs or other ornamentation on the primary disk plates.

3. There is a greater area of exposed side arm plates, both upper and under surfaces of the disk-body.

4. Absence of upper or under plates on the free arm segments beyond disk-body.

5. The pentagonal centrodorsal and radial plates are larger.

6. The absence of the infrabasal disk plates.

7. The symmetrical upper arm plates are smaller and narrower.

The present species is the first to be taken from waters of the North American Continent and the first from Eastern Pacific waters, which geographically separates *Astrophphiura marionae* from the above named species.

It gives me great pleasure to name this species for Mrs. Marion M. Hancock, wife of Captain G. Allan Hancock, Director of the Allan Hancock Foundation, the University of Southern California.

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